

**Notice of Allowability**

Application No.

10/689,958

Applicant(s)

BASCERI, CEM

Examiner

Art Unit

Beth E. Owens

2824

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☐ This communication is responsive to \_\_\_\_.
2. ☒ The allowed claim(s) is/are 1-66.
3. ☒ The drawings filed on 22 October 2003 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some\* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08),  
Paper No./Mail Date 08302004; 10262004; 11092004 *620*
4. ☐ Examiner's Comment Regarding Requirement for Deposit  
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413),  
Paper No./Mail Date \_\_\_\_.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_.



MICHAEL S. LEBENTRITT  
PRIMARY EXAMINER

***Information Disclosure Statement***

1. It is improper to list U.S. Applications on a PTO-1449 form, as they are not publically available. Accordingly, the references to all U.S. Applications have been removed from the forms submitted 09 November 2004 and 30 August 2004 and this serves as part of the official record that the references were considered by the Examiner.

***Examiner's Amendment***

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to Applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

In the Abstract:

Line 1: replace the first sentence with: --A method of forming a conductive metal silicide by reaction of metal with silicon is described.--

Line 2: replace "In one implementation, such a" with --A--.

Line 3: replace "comprising" with --with--.

Line 4: replace "silicon containing" with --silicon-containing--.

Line 5: replace "oxide comprising" with --oxide-comprising--.

Line 6: replace "silicon containing" with --silicon-containing--.

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Line 7: replace "Such" with --This ALD-deposited--.

Line 8: replace "metal rich" with --metal-rich--.

Line 9: replace "plasma exposed" with --plasma-exposed--.

Line 11: replace "silicide comprising" with --silicide-comprising--.

In the Claims:

Claims 2-45 and 47-66, line 1: place a comma after "The method of claim X".

Claim 1, line 4: replace "silicon containing" with --silicon-containing--.

Claim 1, line 6: replace "oxide comprising" with --oxide-comprising--.

Claim 1, line 6: replace "silicon containing" with --silicon-containing--.

Claim 1, line 10: replace "an" with --a first--.

Claim 1, line 10: replace "metal rich" with --metal-rich--.

Claim 1, line 10: replace "plasma exposed" with --plasma-exposed--.

Claim 1, line 11: insert --said first-- before "metal".

Claim 1, line 11: insert --or metal-rich silicide-- before "of".

Claim 1, line 11: insert --the-- before "elemental".

Claim 1, line 12: replace "silicide comprising" with --silicide-comprising--.

Claim 2, line 2: replace "nitride comprising" with --nitride-comprising--.

Claim 3, line 1: replace "nitride comprising" with --nitride-comprising--.

Claim 4, line 1: replace "nitride comprising" with --nitride-comprising--.

Claim 5, line 2: replace "boride comprising" with --boride-comprising--.

Claim 6, line 1: replace "boride comprising" with --boride-comprising--.

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Claim 7, line 2: replace “carbide comprising” with --carbide-comprising--.

Claim 8, line 1: replace “carbide comprising” with --carbide-comprising--.

Claim 9, line 1: replace “oxide comprising” with --oxide-comprising--.

Claim 10, line 1: replace “oxide comprising” with --oxide-comprising--.

Claim 11, line 1: replace “oxide comprising” with --oxide-comprising--.

Claim 12, line 2: insert --second-- before first use of “metal”.

Claim 12, line 2: insert --first-- before second use of “metal”.

Claim 13, line 2: insert --second-- before first use of “metal”.

Claim 13, line 2: insert --first-- before second use of “metal”.

Claim 16, line 1: replace “silicon containing” with --silicon-containing--.

Claim 17, line 1: replace “silicon containing” with --silicon-containing--.

Claim 18, line 2: replace “epitaxially grown” with --epitaxially-grown--.

Claim 21, line 2: replace “of” with --from--.

Claim 22, line 2: replace “of” with --from--.

Claim 23, line 2: insert --said first-- before “elemental”.

Claim 24, line 2: insert --said first-- before “elemental”.

Claim 25, line 2: replace “metal rich” with --said metal-rich--.

Claim 26, line 2: replace “metal rich” with --said metal-rich--.

Claim 33, line 1: insert a colon after “wherein”.

Claim 35, line 2: replace “titanium rich” with --titanium-rich--.

Claim 38, line 2: insert --said first-- before “elemental”.

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Claim 39, line 2: replace “metal rich” with --said metal-rich--.

Claim 40, line 1: replace “silicide comprising” with --silicide-comprising--.

Claim 45, line 1: replace “silicon containing” with --silicon-containing--.

Claim 46, line 4: replace “silicon containing” with --silicon-containing--.

Claim 46, line 5: replace “nitride comprising” with --nitride-comprising--.

Claim 46, line 6: replace “silicon containing” with --silicon-containing--.

Claim 46, line 7: replace “nitride comprising” with --nitride-comprising--.

Claim 46, line 9: replace “nitride comprising” with --nitride-comprising--.

Claim 46, line 11: replace “metal rich” with --metal-rich--.

Claim 46, line 12: replace “plasma exposed” with --plasma-exposed--.

Claim 46, line 13: insert --said-- before “metal”.

Claim 46, line 13: insert --or metal-rich silicide-- before “of”.

Claim 46, line 13: insert --the-- before “elemental”.

Claim 46, line 14: replace “silicide comprising” with --silicide-comprising--.

Claim 46, line 15: replace “nitride comprising” with --nitride-comprising--.

Claim 46, line 18: replace “nitride comprising” with --nitride-comprising--.

Claim 47, line 1: replace “nitride comprising” with --nitride-comprising--.

Claim 48, line 1: replace “nitride comprising” with --nitride-comprising--.

Claim 51, line 2: replace “of” with --from--.

Claim 52, line 2: replace “of” with --from--.

Claim 53, line 2: insert --the-- before “elemental”.

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Claim 54, line 2: replace "metal rich" with --the metal-rich--.

Claim 59, line 2: replace "nitride comprising" with --nitride-comprising--.

Claim 60, line 1: insert a colon after "wherein".

Claim 61, line 1: replace "silicide comprising" with --silicide-comprising--.

Claim 65, line 2: replace "nitride comprising" with --nitride-comprising--.

Claim 66, line 1: replace "silicon containing" with --silicon-containing--.

3. Authorization for this examiner's amendment was given in a telephone interview with Mark Matkin on November 23, 2004.

*Allowance*

4. Claims 1-66 are allowed.

5. The following is an examiner's statement of reasons for allowance:

There is no prior art available nor obvious motivation to combine elements of prior art which teach a method of forming a conductive metal silicide by reaction of metal with silicon, comprising: providing a semiconductor substrate comprising an exposed elemental silicon-containing surface; atomic layer depositing at least one of a nitride, boride, carbide, or oxide-comprising layer onto the exposed elemental silicon-containing surface to a thickness no greater than 15 Angstroms; exposing the layer of thickness no greater than 15 Angstroms to plasma and depositing a conductive reaction layer comprising at least one of a first elemental metal or metal-rich silicide

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onto the plasma-exposed layer; and reacting said first metal or metal-rich silicide of the conductive reaction layer with the elemental silicon of the substrate effective to form a conductive metal silicide-comprising contact region electrically connecting the conductive reaction layer with the substrate; and:

A method of forming a conductive metal silicide by reaction of metal with silicon, comprising: providing a semiconductor substrate comprising an exposed elemental silicon-containing surface; atomic layer depositing a tantalum nitride-comprising layer onto the exposed elemental silicon-containing surface to a thickness no greater than 15 Angstroms, the deposited tantalum nitride-comprising layer having a resistance greater than 1000 microohms-cm; exposing the tantalum nitride-comprising layer of thickness no greater than 15 Angstroms to plasma and depositing a conductive reaction layer comprising at least one of an elemental metal or metal-rich silicide onto the plasma-exposed layer; and reacting said metal or metal-rich silicide of the conductive reaction layer with the elemental silicon of the substrate effective to form a conductive metal silicide-comprising contact region over the tantalum nitride-comprising layer which electrically connects the conductive reaction layer with the substrate; the exposing, depositing and reacting being effective to reduce resistance of the tantalum nitride-comprising layer to less than 1000 microohms-cm.

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Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

6. The following prior art, which is considered pertinent to applicant's disclosure although not relied upon, includes "Methods of Forming Capacitors and Integrated Circuit Devices Including Tantalum Nitride" by Choi et al.

### *Conclusion*

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Beth E. Owens, Ph.D. whose telephone number is 571.272.1882 and fax number for unofficial communications is 571.273.1882.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Elms, can be reached on 571.272.1869. The fax phone number for the organization where this application or proceeding is assigned is 703.872.9306 for official communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 571.272.2800.




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BEO 11.28.04

A handwritten signature in black ink, appearing to be 'BEO' with a stylized flourish.A handwritten signature in black ink, appearing to be 'Michael S. Lebentritt'.

MICHAEL S. LEBENTRITT  
PRIMARY EXAMINER